Chemical Compositions and Methods for Absorbing Water Vapour and Combating Malodour within a Cavity

This invention relates to the use of dehumidifying compositions in absorbing water vapour and malodour from the interior of cavities, for example wardrobes, cupboards, drawers and shoes.

It is known to provide odour absorbing and/or sterilizing compositions for use in combating odour produced by domestic waste and by bodily fluids. In particular, domestic waste placed in bins and waste receptacles can generate significant malodour if left for any period of time, especially when the waste is organic such as food and beverage waste. Part of the malodour may be formed by gaseous compounds released from the waste material, and part of the malodour may be formed by volatile compounds within moisture present in the waste material.

Various odour controlling agents have been disclosed in the literature. Many odour-control materials have been described for use with sanitary articles such as nappies and feminine hygiene bins. US5885263 discloses compositions comprising super absorbent polymers containing boron species, which absorb moisture from waste material in the vicinity of the odour controlling composition. WO 01/52912 discloses absorbent articles, such as sanitary napkins, panty liners and nappies comprising lactic acid producing micro-organisms and odour controlling zeolite compounds which absorb malodours from waste material. WO 91/11977 discloses the use of zeolites having intermediate SiO_2/AlO_2 ratios to control odours in sanitary articles such as nappies and panty liners.

The odour-control compositions disclosed in the prior art discussed hereinabove comprise a malodour absorbing agent in conjunction with a moisture absorbing agent of a type which absorbs water from moist material with which it is in contact.

It would be advantageous to provide a composition which absorbs malodour and water vapour, from a cavity.

According to a first aspect of the present invention there is provided a method of absorbing water vapour and of combating malodour within a cavity, the method comprising the step of introducing into the cavity a package comprising a wall material which retains particulate contents and is permeable to water vapour, the contents comprising a dehumidifying compound, an odour-combating compound and a filler comprising starch or a starch derivative or cellulose or a cellulose derivative.

According to a second aspect of the present invention there is provided a method of absorbing water vapour and of combating malodour within a cavity, the method comprising the step of introducing into the cavity a package comprising a wall material which retains particulate contents and is permeable to water vapour, the contents comprising a dehumidifying compound, an odour-combating compound, and a filler which acts as a thickener or gelling agent for the water inside the package.

The term "contents" is used throughout this specification to denote the mixture of the dehumidifying compound and

the odour-combating compound, and any other materials, mixed therewith, within the package.

Suitably the dehumidifying compound is capable of absorbing at least its own weight of water vapour. Preferably it is capable of absorbing at least twice its own weight of water vapour. The package is preferably manufactured with the dehumidifying compound in a desiccated condition. Preferably the package is kept in a dry environment between manufacture and sale. For example it may be wrapped in a wrapping which is impermeable to water vapour.

The dehumidifying compound is preferably a compound with a high capacity to absorb water vapour. Its capacity to absorb standing water and water entrained in waste materials is not of significance, in this invention.

Preferably the dehumidifying compound comprises an inorganic compound, for example calcium chloride and/or magnesium chloride. When calcium chloride is employed it preferably comprises less than 20wt% of the total contents. A preferred further dehumidifying compound, additional to calcium chloride, when needed, is magnesium chloride.

Suitably the dehumidifying compound is present in an amount of at least 10wt%, preferably at least 20wt%, and most preferably at least 40wt%, of the weight of the dry (total) contents. Suitably the dehumidifying compound is present in an amount of no more than 95wt%, preferably not more than 85wt% and most preferably not more than 75wt%, of the weight of the dry (total) contents.

The term "odour-combating" in this specification refers to any manner in which odour is counteracted by way of a physical or chemical action, for example by absorption, suppression, neutralisation or degradation; not merely odour-masking, as a fragrance alone may achieve.

Suitable odour-combating compounds include zeolites, inorganic carbonates, clays, for example bentonite, cyclodextrins and diatomaceous earths.

Suitably the odour-combating compound is present in an amount of at least 0.1wt% of the weight of the dry (total) contents, more preferably at least 0.5wt%, most preferably at least 1wt%. Suitably the odour-combating compound is present in an amount of no more that 25wt%, preferably no more than 20wt%, and most preferably no more than 10wt% of the weight of the dry (total) contents.

Preferably the odour-combating compound is a zeolite, most preferably comprised within a flowable zeolitic powder.

Preferably a flowable zeolitic powder comprises at least 80wt% zeolite, and preferably at least 90wt% zeolite. It may in certain useful embodiments be constituted substantially entirely by zeolite. When it is not, it may be zeolite admixed with a filler or, preferably, processing aid.

In this specification references to "zeolite" are to substantially virgin zeolite, including bound water of crystallisation and any atmospherically absorbed unbound water that may be present, but not including deliberately

added materials. "Zeolitic powder" denotes zeolite (as just defined) and also such a material containing deliberately added material(s).

Definitions which refer to the weight or weight ratio of zeolitic powder are made with reference to the zeolite (as defined above) in the zeolitic powder, unless otherwise stated.

We believe that the invention can be applied using any type of odour-absorbing zeolite or zeolitic powder, including odour-absorbing grades of the materials known as zeolite MAP, zeolite X, zeolite P and, most preferably zeolite A.

Suitably, the contents comprise a filler (additional to any starch, starch derivative, cellulose or cellulose derivative filler).

By "filler" we mean a compound which serves to increase the bulk of the composition and which, preferably, is substantially water insoluble. It may however have other functions - for example it may be a processing aid, and/or an odour-absorber and/or have water-absorbing properties and/or act as a thickener or gelling agent for the water absorbed within the package.

A filler may be an inorganic filler, for example a metal salt or metal oxide.

A filler may be an organic filler, for example a compound in the cellulose or starch families (as mentioned above in defining the first aspect of the invention).

Suitable fillers include, for example, calcium carbonate, sodium bicarbonate, cellulose or cellulose derivatives, starch or starch derivatives, anhydrous calcium sulphate, calcium oxide, silica gel, and bentonite clays.

An especially preferred inorganic filler is one selected from the alkaline compounds able to neutralise foot acids, such as the Group IA and Group IIA carbonates and bicarbonates, for example, sodium bicarbonate, potassium bicarbonate, calcium carbonate and magnesium carbonate. Sodium bicarbonate is especially preferred.

An especially preferred organic filler is starch.

Suitably a filler (made up of one or more compounds) is present in an amount of at least 10wt%, preferably at least 20wt%, of the weight of the dry (total) contents.

Suitably a filler (made up of one or more compounds) is present in an amount of no more than 80wt%, preferably no more than 60wt%, more preferably no more than 40wt%, of the weight of the dry (total) contents.

As noted above some compounds which are primarily present as a filler may have odour-combating properties. Suitable fillers which have odour-combating properties include inorganic carbonates such as calcium carbonate, clays such as bentonite clays and silica gel.

However, preferred compositions comprise both a highly effective odour-combating compound and a separate filler which may or may not also absorb some odour.

According to this invention a filler which comprises starch or cellulose or a derivative thereof, or a filler which acts as a thickening or gelling agent, is an essential feature. Beyond that, even though some fillers also have some odour-combating properties (or other beneficial secondary properties), in this invention a filler is used in conjunction with a separate odour-combating compound, and is intended primarily as a bulking material, and thus is not an "odour-combating compound" according to the invention.

Preferred contents of the invention comprise a compound capable of absorbing at least its own weight of moisture, especially a magnesium or calcium halide, a filler, especially starch, and an odour-combating compound, especially a zeolite.

The contents may further comprise a fragrance. Many suitable fragrances are commercially available, including those designed to mask waste odours, and the choice of fragrance is a matter of subjective choice. If wished a fragrance may be entrained on an absorbent material, for example on a zeolite employed as an odour-absorbing compound, in order to give slow fragrance release.

The contents may suitably be in the form of a powder, or, preferably, granules (including flakes).

The cavity mentioned above may be an enclosed cavity, for example a drawer, wardrobe, cupboard, locker, refrigerator, freezer, cool box, car boot or car passenger

compartment. Preferably it is a drawer, wardrobe, cupboard or locker.

The cavity may be a non-enclosed cavity, for example the inside of a shoe or boot.

In the method the package is placed inside the cavity and, if the cavity has a closure, it is typically closed. The package acts to reduce the humidity of the air inside the cavity and prevent the development of musty odours.

The package may have a wall material which is all of semi-permeable (by which we mean permeable to water vapour and impermeable to water, that is, liquid water) membrane material or may comprise a portion which is wholly water-impermeable membrane and a portion which is of semi-permeable membrane material.

In one convenient embodiment the package comprises a sachet made up of two sheets joined together around their periphery, for example by heat sealing. Preferably one sheet is of a wholly water-impermeable membrane and the other sheet is of a semi-permeable membrane material.

Suitable technology for the package manufacture is described in US 6217701 and US 5935304.

Preferably the package is such that it can admit at least 500g, more preferably at least 1000g, most preferably at least 2000g water vapour/m^2/day.

The package may have a means for indicating exhaustion. For example the contents may include a component whose

colour changes when the water held by the contents reaches a certain level, indicative of exhaustion or imminent exhaustion. Alternatively the package may be designed to bulge visibly when replacement is needed (whilst being designed to be safe from bursting) or otherwise to be detectable by feel, the contents becoming gel-like when approaching exhaustion. Alternatively the package may be formulated such when replacement is required water is no longer all retained by the contents but some drips therefrom, and collects in a visible, distinct under-zone of the package. In that under-zone it may dissolve a colorant, to aid visual detection, or trigger another type of signal, for example a visible or audible signal.

In accordance with a further aspect of the present invention there is provided a package comprising a wall material which retains particulate contents and is permeable to water vapour, the contents comprising a dehumidifying compound, an odour-combating compound, and a filler comprising starch or a starch derivative or cellulose or a cellulose derivative in admixture.

Alternatively, and according to a further aspect of the present invention there is provided a package comprising a wall material which retains particulate contents and is permeable to water vapour, the contents comprising a dehumidifying compound, an odour-combating compound, and a filler which acts as a thickener or gelling agent for the water inside the package, in admixture.

The package is suitably in the form of a pouch or sachet. For certain embodiments it may be provided with a hook, for hanging within the cavity.

In accordance with a further aspect of the present invention there is provided a particulate composition comprising a dehumidifying compound, an odour-combating compound, and a filler comprising starch or a starch derivative or cellulose or a cellulose derivative, in admixture.

Alternatively, and in accordance with a further aspect of the present invention there is provided a particulate composition comprising a dehumidifying compound, an odour-combating compound, and a filler which acts as a thickener or gelling agent for the water inside the package, in admixture.

The invention will now be described by way of the following, non-limiting examples.

Example 1

In this example the contents of a sachet to be hung in a wardrobe were as follows:

Magnesium chloride in flake form (staple source)	51wt%
Calcium chloride in flake form (Tokuyama)	18wt%
Potato starch in powder form (Nichiden Chemical)	24.9wt%
ZEOCROS E100 (zeolite, Ineos Silicas)	5wt%
ACTICIDE NC preservative (Thor Specialties)	0.1wt%
Microencapsulated fragrance	1.0wt%

These materials were mixed in a tumbler mixer. 55g portions were sandwiched between two rectangular sheets of plastics materials, heat sealed together around their

edges, one sheet being polyethylene impermeable to water and water vapour and the other being of semi-permeable TYVEK membrane material from Du Pont, formed from fine HDPE fibres. The water-vapour permeability in this embodiment is about 2000-4000g/m^2/day.

A plastics hook was adhered to the package to enable it to be hung inside a wardrobe.

When the sachet approaches saturation the contents become gel-like. This condition is easy to detect manually.

In a similar example 27g portions of the same material were employed, between smaller sheets of the same plastics materials. These smaller packages are for use in drawers.

Example 2

In this example the contents of a pouch to be placed inside a shoe were as follows:

Magnesium chloride in flake form (staple source)	40wt%
Potato starch in powder form (Nichiden Chemical)	38.9wt%
Sodium bicarbonate (staple source)	10wt%
ZEOCROS E100 (zeolite, Ineos Silicas)	10wt%
ACTICIDE NC (Thor Specialties)	0.1wt%

These materials were mixed in a tumbler mixer. 100g portions were entrapped between two rectangular sheets of plastics material, heat sealed together around their edges, one sheet being of polypropylene impermeable to liquid water and water vapour and the other being semi-permeable TYVEK membrane material. The water vapour

permeability in this embodiment is about 2000-4000g/m^2/day.

In use, the pouch is placed in a shoe which is damp from wear and/or which requires storage. When approaching saturation the contents became gel-like, easily detected by feel.

ZEOCROS E100, ACTICIDE NC and TYVEK are believed to be trade marks.